The cost of switching Internet providers in the broadband industry, or why ADSL has diffused faster than other innovative technologies: Evidence from the French case

Jackie Krafft, Evens Salies

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"The cost of switching Internet providers in the broadband industry,

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Authors:

Jackie Krafft* and Evens Salies**

Affiliation:

* Université de Nice Sophia Antipolis, CNRS-GREDEG, 250 rue Albert Einstein, 06560 Valbonne, France; Tel: 33 4 93 95 41 70; Fax: 33 4 93 65 37 98; e-mail: Jackie.Krafft@gredeg.cnrs.fr

** Observatoire Français des Conjonctures Économiques, 250 rue Albert Einstein, 06560 Valbonne, France; 33 4 93 95 41 52; Fax: 33 4 93 95 41 22; e-mail: evens.salies@ofce.sciences-po.fr

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Abstract

The innovative broadband Internet industry is characterised by inertia phenomena in terms of technology choice, as well as selection of Internet service providers (ISPs). Within the set of firms providing Internet, very often in Europe the incumbent operator has the lion's share of end-customers and supplies the dominant technology. Focusing on the French case, this paper shows that although inertia on the supply side (partly due to the regulation process in itself), helps to explain the technology mix reached to date, a more complete picture of the inertia can be obtained when we consider the existence of costs faced by customers when switching between ISPs. We calculate these so-called "switching costs". The closing section of this paper derives several implications in terms of policy.

1. Introduction

The Lisbon Strategy explicitly set the goal of making Europe the most successful knowledge-based economy by the year 2010. Of particular importance to this is the enhancement of knowledge-intensive sectors such as the ICT (Fagerberg and Verspagen, 2002). Within ICT, the broadband industry is often considered a test field with respect to the goal of reducing the digital divide (Downes and Greenstein, 2002). With this in mind, a new legal framework has been elaborated for Internet communications markets, implemented by a series of European directives in 2002, with the purpose of guiding member states and their national regulatory authorities as they act. While the desired

outcome is to foster and consolidate competition in markets, we can already observe today some important shortfalls between such political claims and the current dynamics of info-communications in Europe. In various countries, the assessment today is that regulation was often based on wrong assumptions about the future development of broadband activities. Regulation thus either imposed unrealistic purposes to the incumbent, leading to increasing difficulties, or left the incumbent in a comfortable situation with very few requirements (Laffont and Tirole, 2000). Evidence on this can be drawn from the rare occasion when regulators compare themselves to other regulators. For instance, the Japanese approach to regulation appears to be much more interventionist or stronger than the other ones (especially the European ones), and is often perceived as having produced more competition at the industry level (Fransman, 2006). The gaps between political claims and current industry dynamics are usually explained by the underlying asymmetry of information faced by regulation authorities on competitors difficulties in overcoming the incumbency advantages, and more punctually by the inertia of consumers to switch the incumbent. This paper explores these gaps by focusing on the French broadband industry and argues that consumer inertia appears central in their explanation.

The relatively short history of the broadband industry in France (appearing first in the early 2000s) nonetheless provides a solid basis for an economic analysis and actually identifies an important paradox. Although broadband Internet can be delivered by a number of different competing technologies, among these one largely dominates the industry. In 2005, about 72% of end-users were connected via DSL technology; 17% used Wifi, which is often considered as an advanced technology since it provides wireless access; and 4.5% used cable, the initial broadband technology. In addition,

whereas entry has been generally encouraged by the French regulatory authority (Arcep), the incumbent operator France Telecom (FT) still enjoys the lion's share of end-customers: market share in 2005 stood at 47.2%, relying exclusively on DSL-based technology. Widely innovative and competitive, the French broadband Internet industry is undoubtedly characterised by important inertia phenomena in terms of choice of technologies, and also in terms of providers. This is problematic since one of the expected consequences of the emergence of the innovation 'broadband Internet' in France and in Europe as well was the creation of real competition between technologies. What was intended, especially from the regulators' viewpoint, was a decisive contest between the incumbent's choice of technology (DSL) and alternative technologies (such as cable or Wifi) supported by new entrants providing high quality packages at cheaper prices.

Industrial dynamics provides key elements in the analysis of inertia where supply sources are concerned (Malerba, 2002; Klepper, 1997; Krafft, 2006a). As such it provides a potential explanation for why, despite a regulated competition process that encouraged companies to select the best technology and related services at the lowest price, the dominant company (here FT) was finally able to impose the development of DSL as the standard, despite it being neither the optimal nor the initial technology.[2] This paper aims to analyse the causes of the inertia affecting this industry, by investigating both supply and demand factors. We argue that although inertia on the supply side, often shaped by the regulation process in itself, does help to explain the current situation, a more complete picture of the industry dynamics is only obtained when we introduce the costs – the so-called "switching costs" – faced by customers wishing to change Internet provider. These costs include cognitive (or psychological)

costs which will be further documented below, eventually the cost of replacing one's equipment, transaction costs such as the cost of collecting information about alternative offers, and contractual costs in that customers often have to respect a subscription period.[3] This source of inertia on the demand side is paradoxical but nevertheless central to the dynamics of the broadband industry. Paradoxical, since it is commonly said of demand for Internet connection and services that consumers have access to all information about service providers, both in terms of costs and quality-of-service. Crucial, since we demonstrate that the presence of switching costs helps to explain why the incumbent – and hence its technology – are dominant.[4]

One lacks empirical economic analyses on the determinants of switching decisions and barriers to switching ISPs.[5] The UK's regulator for communications conducted a survey in particular with a sample of adult consumers in the Internet market (Ofcom, 2006). That research shows that a little more than 20 percent of them have switched their ISP in the first three months of 2006, and 53% in June 2006 reported having ever changed tariff or package since they have Internet at home. Barriers to switching were not simply difficulties to make comparisons between suppliers (44%) but, also reluctance to leave supplier one's trust (63%). Trust or uncertainty costs about the quality of providers not already tested reduce the willingness to switch as suggested in Klemperer (1995). Only 15% claimed they were likely, very likely or certain to switch their provider to change their connection method, which involves changing technology.[6] In the US, DSL and Cable are the two main technologies to offer Internet access to about 99% of the households, and Economides (2007) recently suggested to explore inertia factors potentially affecting the demand side.

The role we ascribe to consumers in explaining technological inertia differs from the overwhelming majority of papers which follow the literature on network externalities pioneered by Katz and Shapiro (1986). In the literature we have followed it has been shown that large values for switching costs on the consumers' side can lead to the adoption of inferior technologies even if there are no direct network externalities (see Shy, 2002a and references therein; Beggs, 1989). Together with sunk costs of entry, switching costs generate an *indirect* network externality (see Liebowitz and Margolis, 1994, for a discussion of the differences between direct and indirect network externalities). Basically a retail firm's customer does not directly obtain higher satisfaction as the total number of consumers switching to the same technology increases. Rather, the consumer cares about the number of other consumers subscribing to the chosen retailer, since this factor increases the likelihood it will survive in the industry.

In the next section, we give an overview of the broadband industry in France *vs* Europe (Section 2). We then show that in order to understand the dynamics of the broadband industry, it is necessary to consider both supply- and demand-side determinants of DSL's dominance (Section 3). We argue that inertia on the supply side (that is, imitating the incumbent in choosing DSL, reluctance to introduce the novel Wifi technology, and distortion of competition in cable – all three elements being generated by the regulation process in itself) provides only a partial vision of the dynamics broadband industry in France. Yet, inertia on the demand side lies in the presence of significant consumer switching costs which are empirically measurable from actual data on prices and market shares. We define customer switching costs (Section 4) and calculate them using Shy's quick and easy measure (Section 5). Finally, we comment on

our results and present our conclusion with respect to regulation and competition policies (Section 6).

2. Broadband in France *vs* Europe

2.1 Non-DSL technologies lag behind

Broadband communications have become the most important focus in the current evolution of the Internet (Fransman, 2006). Broadband generally means Internet connections of a speed superior to 128kbit/s. Broadband Internet can be provided via different technologies – a dominant one DSL, and alternative ones Cable and Wifi [7] – none of which can be considered as emergent. Of these, DSL (or ADSL for asynchronous digital subscriber line) have diffused faster. Developed in the late 1980s, this technology allows broadband data to be sent over the traditional copper telephone lines that connect most homes and small businesses. It has rather naturally become the incumbent operator's choice of broadband technology because it also owns and controls the copper telephone lines. Cable is an earlier technology that initially attracted a large portion of consumers. Invented and in use by the late 1970s, cable has long been considered as a major infrastructure for the supply of telecoms services requiring high speed. Since 1998, cable networks and co-axial cables, used for cable TV, have been used, together with cable modems, to provide broadband communications and were developed all over the country by cable operators that compete with the incumbent on the local loop access. Today, however, the population of end-users using this technology is stagnating. Wifi is an advanced technology invented in the mid-1990s which allows an over-the-air high speed connection to be made between a radio-enabled

client (equipped, for example, with a laptop) and a base station connected to the local access network. Firms specialised in this technology avoid the use of local loop access which is generally controlled by the incumbent, that is, which corresponds to the incumbent's wire line infrastructure. The number of end-users of this technology is increasing, though at a slower rate than might be expected for an advanced technology.

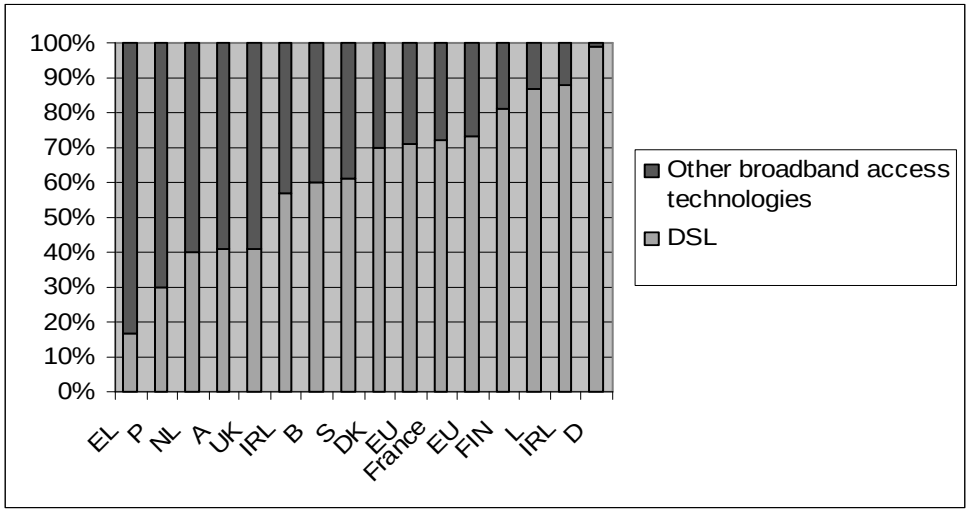

Fig. 1. Breakdown of technologies used for broadband access in European countries (source: Arcep, 2004 and 2005)

DSL technologies also take the lead in wider Europe (see Fig. 1). In France, as in half of the European countries, non-DSL technologies still account for a very low share of the market. In France, 72% use DSL and alternative technologies 28%. Annual reports from Arcep show that in 2004 only five countries (including the UK, the Netherlands and Austria) out of 15 rely on non-DSL technologies as a major source for broadband access. This can be interpreted as DSL domination, and furthermore, that at the end of the day competition from other technologies is not so great in France or most European countries.

2.2 Firms' market share and prices

France occupies an intermediate position in the distribution of incumbent versus new entrant market share in Europe (Fig. 2).

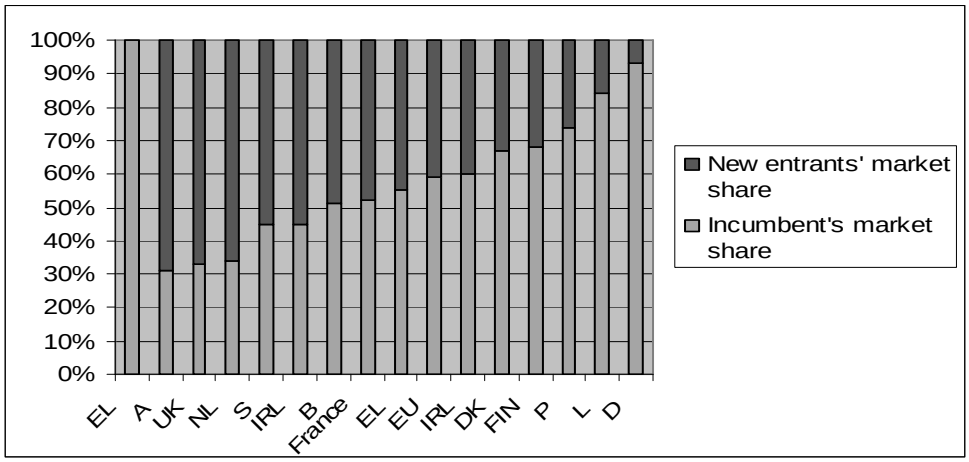

Fig. 2. Broadband market share in Europe, incumbents versus new entrants (source: Arcep, 2004 and 2005)

In 2005, the year to which our empirical analysis relates, nine national operators (each with comparable geographical coverage) compete in the French broadband market (Table 1), seven of which provide only DSL. The incumbent operator France Telecom-Wanadoo leads (47.2%), ahead of same-technology competitors AOL France (7.5%), Neuf Telecom (7%), Alice (6.0%), Tele 2 (4.7%), Cegetel (3.9%) and Club-Internet (3.3%). Iliad/Free, at 16.9%, is the sole Wifi provider. There are also three cable companies providing broadband, with Noos being the only performing firm among these (3.4%).

Table 1. Key figures (in end of December 2004)

Technologies	Cable	DSL	Wifi
Number of subscribers: 6,288,351	211,351	5,049,987	1,027,013
Firms (market share %)	Noos (3.4) [(a)]	France Telecom (47.2) AOL France (7.5) Neuf Telecom (7.0) Alice+Tiscali (6.0) [(b)] Tele2 (4.7) Cegetel (3.9) Club Internet (3.3)	Iliad/Free (16.9)

Source: Arcep (2005) and 01 Réseaux (2005). Note that our figure differs slightly from the actual figure 6,529,997 that includes all operators, even the very small ones.

[(a)]. As the number of Noos' customers was only available for the end of September 2004, we extrapolated the data in the table. We applied the rate of growth of all broadband customers in the last quarter of 2004 to the figure in the end of September 2004.

[(b)]. This data is for March 2005. Alice, an affiliate of Telecom Italia merged with Tiscali France in March 2005.

It appears from these elements that FT, which is at the origins of the leading technology, dominates having attracted the largest share of subscribers.

In broadband Internet and in the computer industry overall, a large lead in price and speed by one firm over an incumbent should have attracted new customers and been sufficient to motivate a buyer to incur the cost of switching for the additional benefits (Greenstein, 1997: 257). But in our case, adoption mechanisms by end-users must be strongly characterised by inertia. This situation is puzzling given that most ISPs entered the marketplace with cheaper offers, as shown in Table 2. This table lists monthly prices offered by the nine main broadband ISPs. When that was possible we excluded offers inclusive of access to TV channels to increase homogeneity between firms. Once

installed, technologies compete mainly on the basis of prices offered and the speed available to consumers. While speeds range from 4 to 20 Mb, ISPs offer at most three levels, as seen in the table. At present, apart from Tele2 and Noos providers offer the average download speed and all offer at least 16 Mb. This has two obvious implications. Firstly, consumers need not switch their current provider to reach higher download speeds. Secondly, switching may however cost the consumer. For example, DSL consumers must replace their modem.

Table 2. Supplier tariffs

Speed (Mb)	Wanadoo FT [a],[b]	Free Iliad	AOL	N9uf Telecom	Alice+ Tiscali	Tele 2	Cegetel	Noos	Club-Internet
1								24.90	
2						23.85			
4			34.90						
6		29.99				14.85			
8	29.90		19.90		29.95				26.90
16		29.99		23.90	29.95		14.90		19.90
18	37.40		19.90						
20		29.99							
(1)	12				12			12	12
(2)		60.00	49.00	45.00		60.00	40.00	40.00	
(3)	36.00		49.90	36.00		30.00	36.00	29.90	60.00
(4)	36.00	60.00	98.90	81.00	00.00	90.00	76.00	69.90	60.00

(1): Subscription period.

(2): Cancellation fee, in €. Iliad/Free charges €96 – €3 × the number of months in order to cancel the contract. The Noos cancellation fee corresponds to cable disconnection.

(3): Cost of the Modem. Immediate purchase in the case of AOL. Cost of a 12-month rental for other firms. Starting fee in the case of Noos.

(4): Sum of (2) and (3).

[a] FT's 18 Mb offer costs €29.90 for the first three months, rising next to €39.90.

[b] Alice and Iliad/Free offer free unlimited access to phone services. Access to TV channels is optional in the cases of FT, Free, N9uf, Noos and Club-Internet. It often requires a different modem and involves an extra fee thus excluded it from our data.

Source: price data were taken from http://www.dslvalley.com and French national press during the period December 2005–May 2006. They are available upon request from the authors.

Cells '(1)' to '(3)' outline the existence of a subscription period or not. Firms also vary with respect to demanding a cancellation fee, its level and of the rental or one-off purchase cost of the modem. We note that firms substitute a subscription period for cancellation fees, the only exception being Noos which includes both.

To conclude this section, the competition in technologies predicted by regulation authorities in fact is not so great, with the penetration of new entrants' technologies being very low. Competition between firms, being another factor favoured by competition authorities, ended up under the domination of the incumbent, France Telecom. The broadband industry is thus characterised by significant inertia phenomena, as analysed in the following section.

3. Causes of inertia

One could conclude that the causes of inertia in an industry like broadband essentially come from the supply side. The incumbent, France Telecom which has operated in the sector for decades and necessarily enjoys a first-mover advantage, dominates the industry. However, one could also suppose that regulation may have produced at least a counter-balancing effect by stimulating the entry of high-performing new ISPs with the same technology at lower Internet subscription fees, or new entrants with radically new technologies. Any such counter-balancing effect proved to be rather ineffective indeed. In this section, we further underline the fact that inertia also has strong demand-side determinants, which is less evident in a sector where end-users can collect all the information necessary to compare prices, services and select the best provider with the most efficient technology. Finally, we argue that there is a link between technology and

demand inertia. A low level of switching between providers may imply the dominance of a certain technology. A competitor that enters with an alternative technology knows that it may not attract the incumbent's customers easily as these customers would have to learn how to use this alternative technology. Such learning represents a kind of switching cost. In fact, the majority of new entrants in broadband Internet (six out of eight) entered using the incumbent's technology.

3.1 Inertia on the supply side: imitation of the incumbent, reluctance to introduce novel technologies, and distortion of competition as related effects of the regulation process

Inertia on the supply side may be the result of various elements. The literature on technology adoption provides a series of empirical results, including "leaders and laggards" issues. In the manufacturing industry, Klepper (2002) compares very competitive and oligopolistic markets to suggest that competition plays a strong role in the adoption of cost-reducing technology. In network industries, Dranove and Gandal (2003), and Gandal, Kende and Rob (2000) also document that competitors are not always incited to adopt quality-enhancing technologies and standards. In the narrowband industry, Augereau and Greenstein (2001, 2004) argue that ISPs were often reluctant to adopt 56K modems as more of their local competitors had done so.

The "first mover effect" described in industrial dynamics (Klepper, 1997; Agarwal and Gort, 1996; Green *et al.*, 1995) can explain how, in an industry where the development of a new technology is based on previous investments in infrastructure and facilities, the incumbent may win in most cases. The first mover is able to enjoy economies of scale

and scope, may benefit from existing market domination in related markets (fixed and mobile services), has greater financial facilities and better brand recognition. This kind of argument is also consistent with the literature on network externalities (Economides, 1996; Katz and Shapiro, 1986). The firm that has invested in essential facilities and occupies a dominant position in related markets (here, for instance, fixed and mobile telephony) may well maintain its leading position and survive fierce competition instigated by new entrants (Bernheim and Winston, 1985).

However, it is also conceivable that new entrants, offering cheaper products/services than the incumbent doted with the same technology, or offering higher quality services with a radically new technology, may gain important market share. There may be thus a "new entrant effect" that could counterbalance the "first mover effect", in this way limiting inertia phenomena, for the following reasons. New entrants arrive with new technologies that incumbents were not incited to develop, and their small size favours reactivity to market opportunities (Klepper, 1997; Geroski, 1994). This idea clearly motivated the implementation of regulation policies in broadband, and more widely in the telecoms industry (Laffont and Tirole, 2000). New entrants were deemed to out-perform incumbents (Fransman, 2002). The notions of timing of entry and cohort of entrant can provide some substance to the role of new entrants: even a late mover may challenge the incumbent, although very often in a small market niche (Klepper, 1997; Klepper and Simons, 2005).

The lessons to be drawn from the introduction of regulation policies in the French broadband industry proved quite a contrast, since the new entrants did not in the end out-perform the incumbent, and the incumbent is still largely dominant (as is its

technology). Thus the "first mover effect" clearly occurred and prevailed over the "new entrant effect".

Various elements can account for the prevalence of the inertia phenomenon which we observe in the French broadband industry. Imitators of the incumbent technology, such as AOL, Cegetel, Club Internet, Neuf Telecom and Tele 2, provide cheaper services (see Table 2) using the same technology, but appear as minor players. In this case, imitation may not be the key to success in a situation where the incumbent has established brand recognition. Despite its user-friendly characteristics, Wifi is underdeveloped. Iliad/Free is the only provider of this kind of technology, and still occupies a relatively small portion of the market. New entrants thus appear to be reluctant to develop new advanced technologies (Wifi, but also satellite and FTTH), which is relatively surprising in a market which is not yet mature. Cable started quickly but is stagnating today. In fact, the incumbent operator has large shareholdings in competitors Noos, NC Numéricable, and UPC France, owning directly or indirectly 40% of the capital of cable operators. This reveals that this particular type of competition distortion induced very low incentives to develop the cable technology in France, a distortion that does not exist in most European countries where end-users rely more widely on cable (Krafft, 2006b).

The different sources of inertia, however, are related to the regulation process undertaken since 1998. In a number of countries, including France, regulators at the beginning of the broadband era hoped that "infrastructural" or "full facilities-based" competition would emerge and speed broadband diffusion. In that perspective, from 1998 until 2002, France essentially encouraged the emergence of new technologies

developed by newcomers which were deemed to overcome the incumbency advantages.[8] The fact that these new technologies could require important upfront costs was not perceived both by the regulators and by the newcomers themselves as a limitation, since massive funding could be obtained from the stock market at that time. For most of the companies that entered, the usual strategy to develop their own network was to obtain a license from the regulator to operate at the local or regional level, for instance in large urban centres, that could be extended later to a national licence.[9] However, the outcome of this first period of regulation policy that corresponded to the emergence of the broadband era is that infrastructural competition proved to be very limited at the end of the day. This first step in the regulator's strategy did not really provide the expected results. First, the demand for broadband did not really take off at this time. Until the end of 2002, demand for broadband still remained stagnant and operators that entered two or three years later could not develop adequately their business strategy. Second, the financial crash that occurred in the early 2000 questioned the viability of the newcomers that relied on stock markets or bank loans to finance their infrastructure project, up to the point of bankruptcy or exit from the French/European market for many of them. In the beginning of the broadband era, thus, the "first mover" effect already dominated over the "new entrant" effect, in a context where regulation imposed only weak directive requirements on the incumbent.

Only in a second step, over the period 2002-today in France, regulators turned to a stronger form of infrastructural competition, known as the "local loop unbundling or LLU".[10] LLU is a regulatory process by which the incumbent exchange lines are physically disconnected from the incumbent's network and connected to the new entrant's network. This allows the new entrant, by installing its own equipment in the

incumbent's local exchange, to use the incumbent's local loop to provide services directly to consumers. A major benefit of LLU is that it facilitates a degree of facilities-based competition since it gives a new entrant an important degree of control over the local access network. However, the counterpart is that the incumbent's incentive to invest in upgrading the local loop has been diminished as a result of low price access to this network being given to the competitors by regulation. The key issue is thus the definition of a regulated access price which is sufficiently high to give the incumbent a reasonable rate of return on its investment in the local loop, while at the same time being sufficiently low to give new entrants a sufficient incentive to engage in innovative competition with the incumbent. In France, LLU was materialized by three different options in 2002: Option 1 corresponding to "unbundled local loop" where all the access and collection of DSL is operated by competitors of FT; Option 3, corresponding to "shared access" where FT is the essential provider of the local loop while the access and collection of DSL traffic is operated by competitors of FT; and Option 5, corresponding to "wholesale" where FT remains the provider of access and collection of DSL traffic at the local loop and national levels. The main objective was to improve operating conditions for unbundling and service quality in densely populated areas and encourage access migration from Option 5 and Option 3 to Option 1. Another objective was to expand the geographical coverage of DSL, to serve the greatest number of users in large towns as well as in less densely populated areas. These motivations to apply LLU helped to create favourable conditions for the emergence of a more diversified offering and a decline in prices, leading a larger number of customers to use Broadband Internet. In the meantime, however, it also gave greater incentives for newcomers to stick to the supply of mandated services provided by the incumbent. In summary, LLU fostered intra-platform competition, and did not favour competition among technologies, since it

turned out for new entrants that it was less costly to apply DSL then to diffuse an alternative technology. At this stage of a greater maturity of the broadband era, thus, the "first mover" effect reinforced its domination over the "new entrant" effect, in a context where regulation now imposed strong directive requirements on the incumbent, together with an increasing technological lock in to DSL from the competitors' side.

Though these explanations can account for the dominance of the large, incumbent firm, we argue that there are also strong inertia factors on the demand side that have to be explored.

3.2 Inertia on the demand side: a role for switching costs

Though broadband ISPs entered the marketplace by offering an Internet access technology of their choosing (modem, connection equipment), the consumer's fundamental objective when selecting a provider is to access the Internet cheaply, regardless of the technology that accompanies this offer. Therefore by not switching to an unknown albeit cheaper entrant, it could be said that consumers voluntarily choose not to switch to another technology. Accordingly, the high cost of switching brands would not only be a cause of consumer inertia but also of technological inertia.

Unlike most of the literature, the assumption that end-users seek compatibility between technologies seems irrelevant here.[11] Almost all on-line services available on the Internet do not vary according to the technology used by broadband consumers. Thus it is not expected that the user's value from using a certain technology increases with the number of adopters of that technology. Put another way, technologies were neutral vis-

à-vis Internet services available to customers and they were not used by providers as a means of segmenting end-users with respect to Internet practices. Therefore, firms mainly advertised their offers on price and speed. Given the low degree of local loop unbundling in the year considered (only 275,600 subscriptions in 2004), they advertised less on extra services (e.g. access to TV channels, unlimited access to phone services) and rarely on performance, at least in the first years of the market. We notice data on performance are not available to us at regional level thus it is impossible to relate the choice of a firm/technology by consumers with respect to this variable. Obviously, the reliability and the availability of the different network connection technologies depend on consumer living location. Unlike DSL, cable was not available in most locations, and for some technologies such as DSL performance degrades the farther the user is from the central switching office. Wifi customers have nonetheless some benefit in that the technology allows a more flexible utilisation but without affecting the range of services available to these customers.[12] Thus, despite the publication of a huge amount of information concerning the different network connection technologies available, it is not certain that all consumers know how to rank these technologies or have an interest in doing so. To summarize, we assume that, prior to use, most DSL and Wifi consumers are indifferent about the choice of technology to adopt, since they are generally incapable of ranking them according to the service quality these technologies will provide. Consumers would be more responsive to the range of speeds available from their provider, which could clearly be an element of vertical differentiation, though this hypothesis is not tested in the present paper.

In a model with decreasing average costs and a sufficiently large switching cost, Beggs (1989) provides a theoretical foundation for this observation. Switching costs and

decreasing average costs together generate an indirect network externality in that the greater the number of consumers who buy a firm's product, the more likely it is to survive and the more attractive it is to other customers, regardless of whether this product performs better. This firm's price would inevitably be low if it wanted to serve all customers. Thus, any consumer could expect a low price should he or she select that firm, provided that all other consumers select that firm too. This theoretical result is relevant to our research as the condition that consumers' preferences exhibit direct network externalities (Katz and Shapiro, 1986) is not necessary for Beggs's result to hold.[13]

Schematically, the utility of each customer of Internet supplier *a,* using technology 1 (for example Cable), does not need to increase directly with an increase in the total number of consumers adopting technology 1. The Beggs (1989) model suggests that it is likely to increase with an increase in the number of consumers subscribing to *a.* In the author's words (p. 437): "…the more consumers who buy a product the more likely it is to survive and the more attractive it is to other consumers." It is nonetheless important that all consumers have sufficiently large switching costs to rule out the possibility of subscribing to another provider in a later period.

If inertia on the demand side lies in the presence of significant consumer switching costs, it may be valuable for this paper to measure them. The Beggs model is however not very suitable for measuring switching costs. It contains a large number of parameters on firms' costs and consumers' willingness to pay. Beyond this, consumers only differ with respect to their valuation of the product/service they purchase. They are not attached differently to the different brands. And finally, there's only one surviving

firm at equilibrium. The model thus does not capture two essential features of the broadband industry, which we believe are brand differentiation and the perceived cost of learning how to use the different (albeit substitutable) technologies. Firms did not enter the market simultaneously and there is a long-established incumbent competing with new and aggressive entrants. In Shy's model (2002b), which we shall use to calculate switching costs, there are more than two firms. These firms are differentiated with respect to switching costs in that consumer switching costs can be asymmetric between firms in the theoretical model. More important, this model has the advantage over Beggs' and others' model of suggesting a solution of a central problem of the theoretical literature on consumer switching costs, how to measure them? Furthermore, it requires only data on prices and market share (Shy, 2002b).

4. Details on switching costs in broadband Internet

Considering that ISPs provide 'homogenous' access to the Internet, consumers will select a particular provider mainly on the basis of the prices it offers, its speed, its reputation and to what extent they perceive a large cost of switching to an alternative provider with a potentially different technology. All models on consumer switching costs rely on the following premise. If a consumer is initially indifferent as between the services of two competing providers, the fact of using a brand will change her relative utilities for the products, meaning that she will perceive a cost in switching brands. Let us consider what types of costs a typical switcher faces in residential broadband markets.

They are essentially a cognitive (or psychological; see Klemperer, 1995: 518) cost, plus the eventual cost of switching to an alternative technology. The former would refer to

people's desire to reduce cognitive dissonance or the psychic "cost" of exposure to information dissonant with staying with one's current ISP. For example, one would not search for alternative ISPs' offers to avoid the discomfort of learning that there are cheaper offers with similar quality level. Cognitive costs are likely to increase with brand reputation and experience with one's current supplier.[14] Reputation may play a major role in the broadband industry where firms are ranked according to the quality of service they provide to customers. The different existing technologies require specific investments in terms of how to use them (learning costs), because they involve different technical difficulties. A consequence is that once a large base of customers invests in one provider's technology, that provider may have no incentive to design one or more of the alternative technologies already supplied by competitors. Transaction costs in closing an account with one's current provider and opening another with a competitor are systematic and may imply changing e-mail addresses. This could be measured in terms of the value of lost time involved. In some cases, consumers have to pay cancellation fees that may be relatively high (up to €96 with some providers). Consumers must also find out which ISPs operate in their local area, and which offers the best package for their needs. However, this specific transaction cost based on comparison and selection of providers is significantly lower in the broadband industry (compared to other industries), since free ranking services are available on the web. Contractual (or artificial) costs are also present in that customers often have to respect a subscription period, generally 12 months. Switchers may also have to pay the cost of changing to a different modem or a radically different technology to access the Internet (Economides, 2007). We are not in a position to calculate these different costs individually without more documented data on broadband consumer behaviour. We shall however attempt to calculate the net cost of switching to an alternative technology

using an approximate albeit quick measure suggested in Shy (2002b). In doing this, we attempt to complete the supply-side analysis of the reasons for this inertia, measuring the per customer switching costs as between ISPs offering broadband.

5. A measure for switching costs in broadband Internet

There were twenty eight ISPs in the first semester 2005, of which nine with a market share of greater than 1% were retailing a broadband Internet connexion to household consumers. We retained those nine, their tariffs and relative market share which are set out in Table 3.

Table 3. Internet offers

Technology [(a)]	Provider	Market share (%)	Annual fee
DSL	FT [(b)]	47.21	439.80
Wifi	Iliad/Free	16.93	419.88
DSL	AOL	7.47	397.70
DSL	Neuf	6.99	367.80
DSL	Alice+Tiscali	6.02	359.40
DSL	Tele 2	4.77	322.20
DSL	Cegetel	3.88	254.80
Cable	Noos	3.36	368.70
DSL	Club-Internet	3.34	340.80

[(a)]. No entry indicates a firm that mainly provides DSL.

[(b)]. FT's fee is obtained as follows $36.00 + 12 \times \frac{1}{2}[29.90 + (29.9 \times \frac{3}{12} + 39.90 \times \frac{9}{12})]$.

Source: data reported from Table 1 and Table 2.

We ranked firms according to market share, from highest to lowest. Across firms, prices and market share are almost positively related (see also Fig. 3). FT records the highest average price and also the highest market share while the second largest firm charges the second highest price (the magnitude of the correlation coefficient between annual fees and market share is 0.66). We were able to consider the nine providers set out in Table 2 by taking the average price across the different speeds offered. It would have certainly been more accurate to consider a single download speed but this would have meant excluding several suppliers from the analysis. The speed that corresponds to the highest number of providers, five exactly, is 16 Mb. However, FT does not have a 16 Mb offer and we wanted to include the incumbent in our analysis.[15]

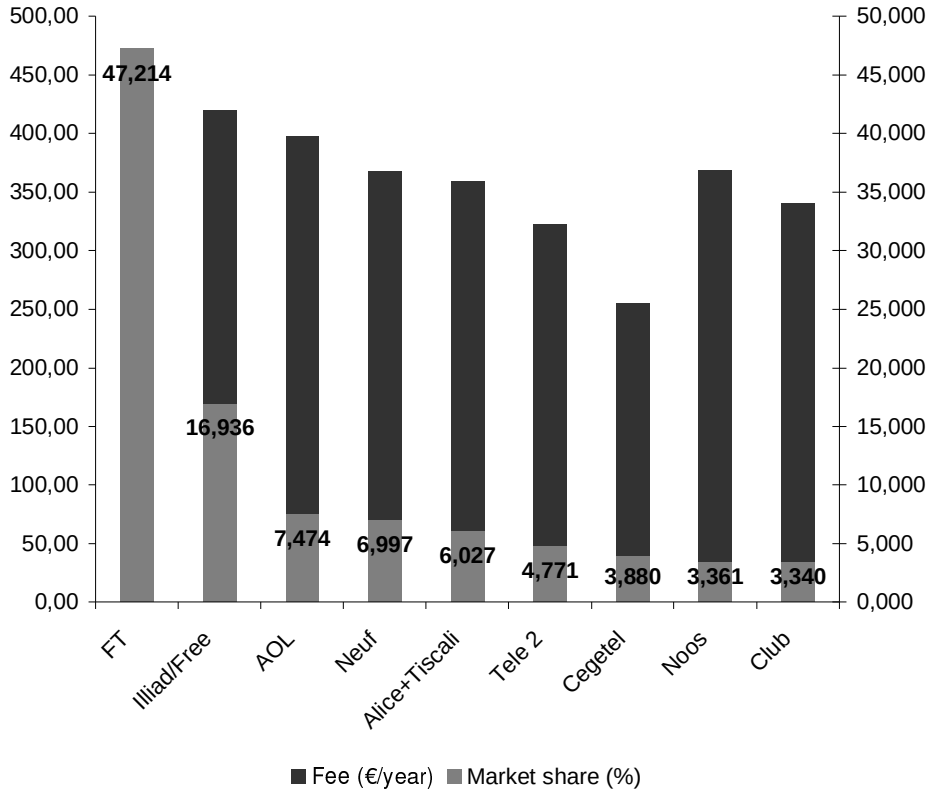

Fig. 3. Prices and providers' market share.

We arbitrarily consider the case of customers who receive a modem from their selected provider and remain a customer for one year. This has some implications for computed

tariffs; for some providers, the customer must pay cancellation fees at the end of a 12-month subscription period, and these have been included in our analysis. Taking into consideration customers of more than one year would (inconveniently) necessitate having to account for changes in tariffs (some firms change their tariffs after a 12-month subscription) and make assumptions on how consumers discount the future.

Our calculation of switching costs uses Shy's measures (2002b). The model assumes that firms set prices. Each firm considers whether to undercut one and only one competing firm at a time. The generic model is thus restricted to the description of competition between two firms. Two firms a and b sell a homogenous service to N consumers. There are $N_\alpha>0$ brand a-oriented consumers (type α) and $N_\beta>0$ brand b-oriented consumers (type β), with $N\equiv N_\alpha+N_\beta$. Type α consumers incur a cost s_{ab} of switching to firm b while type β incur a cost s_{ba} of switching to a. The model solution (see Shy, 2002b) leads to the following measure of switching costs for type α $s_{ab} = T_a - N_\beta T_b / N$ and the following for type β customers $s_{ba} = T_b - N_\alpha T_a / N$, where T_a is firm a's price and T_b is that of firm b.

Besides, it allows for negative switching costs. A negative value for say s_{ba} can be interpreted as a willingness to switch from b to a but price differential (the monetary gain from switching) is actually too low to induce switching. Consequently, we prefer to interpret switching costs as net values. The use of the concept of net switching costs in Shy's model requires recourse to the concept of added-value introduced by Green (2000). Net switching costs is the difference between a gross cost of switching and an added-value (the positive extra utility that customers attach to the target firm). The gross cost of switching includes transaction, contractual, cognitive and potentially

technology-related switching costs (see section 4). The value given to the likelihood that the origin (target) firm will survive is assumed to enter the cognitive part (added-value) of gross (net) switching costs. There is however an obvious limit to Shy's model that it is worth mentioning now. Shy's model is applied to old users and does not distinguish between them and new adopters.[16] Besides, there are no indirect network externalities, which is not a major shortfall, for this assumption would require further and unknown parameters as we discussed in our review of Begg's model.

We calculated switching costs between the nine firms. We selected Noos and Iliad/Free to enable us to measure the potential influence of technology-related learning costs. AOL was chosen on because it is the oldest firm competing with FT in the French broadband market. Tele 2, Cegetel and Club are small entrants in the DSL market thus we expect their customers have small switching costs. Our results for the measurement of switching costs appear in Table 4. The outcomes of our calculation of customer switching costs reach high values, including up to the level of annual fees. For example, the highest switching cost calculated is €420.45, which is only slightly below FT's average price (€439.80). This means that a typical FT customer who wishes to switch to Cegetel stands to save €185 (439.80–254.80) but would incur switching costs of €420.45 (see Table 3).

Table 4. Switching costs (€) in the French broadband retail market

		Target firm								
		FT	Iliad/Free	AOL	Neuf	Alice+ Tiscali	Tele 2	Cegetel	Noos	Club
DSL	FT		328.95	385.45	392.33	399.12	410.23	420.45	415.30	417.29
Wifi	Iliad/ Free	96.19		298.11	312.35	325.55	349.07	372.38	358.83	363.75
DSL	AOL	18.01	106.38		219.86	237.26	272.17	310.63	283.33	292.45
DSL	Neuf	–15.23	70.68	162.39		201.48	237.18	276.91	248.16	257.70
Cable	Alice+ Tiscali	–30.61	49.72	139.24	161.80		217.04	259.61	227.40	237.89
DSL	Tele 2	–77.24	–5.40	79.45	103.51	121.59		207.91	169.81	181.87
DSL	Cegetel	–151.60	–86.81	–6.99	18.20	36.16	77.12		83.67	97.16
DSL	Noos	–41.87	18.35	94.36	120.24	137.97	179.67	232.17		198.85
DSL	Club	–69.95	–9.92	65.92	91.83	109.54	151.27	203.86	155.86	

Source: calculations of the authors from the data in Table 3.

From our empirical results, the broadband Internet industry exhibits the key characteristics of an industry with customer switching costs. Interestingly, the largest and second-largest firms are also those which charge the highest prices on average and whose customers generally have higher switching costs. Switching cost theory provides a nice explanation for that. New comers tend to enter with introductory offers or discounts (see Chen, 1997) to undercut larger firms already present in the market in order to grab not only these firms' customers but also new customers. Once won,

customers develop brand loyalty even where entrant firms are concerned, meaning that these firms can later maintain or charge higher-than-average prices. Firms thus have an obvious interest in competing for market shares when consumers show inertia, for current market shares are an important determinants of their future profits (Klemperer, 1995, p. 520).

FT's market share has decreased since market deregulation while new entrants Neuf, Cegetel, Club, AOL, Alice and Tele2 won 129,000 customers during the third quarter of 2005 alone. It is certain that these firms' customers switch mainly on the basis of price rather than technology, as these firms and the incumbent all use mainly DSL. FT also wins new customers, attracting 335,000 during the same period. We believe these new customers almost certainly attach a high value to the firm, whose reputation has not deteriorated. Given its market share, potential new customers may well perceive FT as being the firm most likely to survive.

Between FT and Iliad/Free, customers' switching costs must be of a different nature since these firms did not supply the same technology over the period studied. Our result shows that the cost of switching from Iliad/Free is quite high while that of switching from Neuf and smaller firms to Iliad/Free is comparatively small. There may be several reasons why Iliad/Free's customers are significantly locked-in. First, Wifi technology may create a particular degree of attachment to Iliad/Free. Besides this, we also believe that customers who chose Iliad/Free made their choice on the basis of its high-speed offers. Iliad/Free won 130,000 new consumers during the third quarter of 2005 by supplying not only an alternative technology, but also cheaper and higher speed offers than the established firm.

We notice the presence of switching costs explains price competition when new groups of customers enter and can be charged separately from others. As an illustration, Cegetel increases the price of its 6 Mb package after a 12-month subscription. The 18 Mb offer from France Telecom is priced at €29.90 the first three months then rising to €39.90.[17] This practice is referred to in the literature as 'bargains-then-ripoffs' pricing, where firms can increase their prices once customers are locked-in. But the negative costs of switching support the observation that the incumbent is likely to win back lost customers. Cegetel's customers bear a negative cost of switching to FT of –€151.6, which is interpreted as a disutility of staying with Cegetel. But we note that this disutility is insufficient to induce current Cegetel's customers to make the switch to FT. FT's annual fee (switching cost inclusive) €439.8 + (– €151.6) = €288.2 remains larger than the price charged by Cegetel, €254.8. It seems very likely that Cegetel or Tele2 will leave the market through failing to lock their new customers in. To respond to this market pressure Neuf and Cegetel merged in August 2005.

6. Conclusion: further discussion and policy implications

Broadband Internet can be provided by different technologies, one of which – DSL – widely dominates this market and is supplied by the large incumbent, France Telecom. This paper has shown on empirical grounds that this situation of technological inertia can be explained by customer switching costs and by other supply-side factors, including regulation issues. Switching costs act as a barrier to customer mobility thus bringing about a dominance of the technology supplied by the largest firm, in this case, France Telecom.

Overall large (respectively small) broadband providers tend to serve customers with high (respectively small or negative) net switching costs. Wifi technology could entail a particular lock-in. Historical factors play a major role here as the firm providing it, Iliad/Free, entered the broadband market not only with cheap prices but more importantly, it supplied higher-than-average connection speeds. We believe that Wifi technology may have been confused with high speed. The range of speeds provided by a firm warrants future research as an element of vertical differentiation common to all firms while they would be – horizontally – differentiated with respect to switching costs. This assumption remains speculative in the French context as no household survey is available regarding customers' choice of broadband ISPs.

Some firms' customers seem very likely to switch back to the incumbent but find this transaction too costly. This raises policy concerns as it suggests not only that the number of firms competing with FT is likely to decrease but also that future entrants will have difficulty grabbing new customers. Price differential is insufficient to induce switching but also too high to make entry profitable. Any action to reduce switching should be taken by the relevant institutions, provided the benefit to society can be expected to outweigh its costs (including the cost of taking such action). An accurate measure of switching costs is thus considered necessary.

The European directives on broadband communications markets implemented in France in line with the Lisbon strategy have not yet produced the targeted outcome of fostering and consolidating competition. Rather, high switching costs have seemed until now to impede such competition by widening the gap between large leading companies (FT

and Iliad/Free) and smaller laggard competitors, by generating an inevitable consolidation movement among small competitors, and by preventing profitable entry. Under these conditions, the objective of increasing competition in the future is also questionable, since in 2005, at the time we collected data for our empirical study, FT's projected strategy was to develop Wifi as well. This Wifi development strategy, together with attractive price differentials, that is, sufficient to induce customers to switch, may eventually alter Iliad/Free's position if its customers are primarily attached to the Wifi technology.

Future possibilities, especially in terms of policy, would thus be whether the development of a knowledge-intensive, fast growing and non-mature industry can still be enhanced by only one dominant company, namely France Telecom. In our view, this would logically require some sort of re-regulation to avoid the effects of consumer switching costs on the diffusion of new technologies. To us, re-regulation could involve, as far as consumers' switching costs are concerned, to consider *ex ante* (before opening the market to entry) and over time that if new competitors do not attract new consumers, this is not because of their cost inefficiency, or because their product is objectively of lower quality, but because consumers may be stuck to their current suppliers. This claim is obvious if consumers are not well informed about the alternative technologies. At a practical level, re-regulation could play the role of providing evidence on the comparison of competitors, and to give customers clear and readable information on the different competing offers. On the basis of the switching evidence that regulation authorities provide and diffuse over time, competition authorities might be able *ex post*, when the measure of switching costs is prohibitively high and persistent over time, to infer that artificial switching costs exist, and to adopt as a consequence decisions

forbidding broadband operators' anti-competitive behaviours. This measure of switching cost would act as an indicator of important deficiencies at the level of consumers to adopt the technology they want or to change suppliers easily. In that perspective, regulation and competition policies can be viewed as complementary rather than substitutes, as this is generally presented however in recent contributions (Shelanski, 2005; Waverman, 2006; Alleman and Rappoport, 2005; Cave, 2006).

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[2] For an interpretation in terms of systems of innovation in the line of Antonelli, 2003; Pavitt, 2001; Metcalfe, 1995; Freeman, 2002; Nelson and Nelson, 2002; Lundvall et al., 2002, Mowery and Simcoe, 2002, see Krafft, 2004, 2006b.

[3] In the UK, for example a broadband consumer has to obtain a transfer code from her current provider (Migration Authorisation Code), which is specific to her, before she is able to switch.

[4] A series of papers (Suarez, 2004; Murmann and Frenken, 2006) has recently proposed an integrative or systematic framework for understanding the process by which a technology achieves dominance when battling other technological designs. Our perception, in the case of the French broadband industry, is that the level of switching costs that we measure impedes the adoption in a short time span of competitive and advanced technologies, reinforces the credibility of the incumbent with the largest installed base, discards cheaper pricing strategies, and perverts regulation frameworks. All these points are discussed in the paper.

[5] There exists a literature on the effects of switching costs on buyer choice of vendor and on new product adoption in the market for routers and switches in the US (see e.g. Chen and Forman, 2006 and the references therein). In This literature, buyers are firms whereas our objective is to focus on household consumers.

[6] These percentages are derived from different samples of consumers.

[7] Besides cable and Wifi, alternative technologies also include satellite and FTTH (Fibre To The Home) which are not considered here, since they concern a very limited number of end-users.

[8] The UK and Korea implemented the same type of "infrastructural competition" regulation policy from the mid 1990s to the late 1990s, with also very limited results (Fransman, 2006).

[9] Many new US or European operators were among these new entering companies, such as 21st Century, 360 Networks, Winstar, Titan, Iaxis, Dynegy, or Iliad/Free and thus applied for a local or experimental licence. This wave of entry was also composed of a number of cable operators that could also provide alternative networks and were thus considered as credible competitors.

[10] This second step in regulation policy occurred also in most of the developed countries that implemented so far only a weak form of regulation. Japan is perhaps the only exception, since this country applied strong regulation policy, oriented towards strict local loop unbundling from the very initial development of the broadband era (Fransman, 2006).

[11] For example, Greenstein's (1997) critical point is that switching costs in the mainframe computer vending market arise due to incompatibility between operating systems or hardware.

[12] Conversely, mobile phone providers can discriminate between consumers on the basis of the sophistication of the mobile, that is, whether it includes a camera, enables access to the Internet, and so on.

[13] There are several reasons why consumers may prefer a technology having more ISPs servicing it. The most relevant here (see Greenstein, 1997: 9) is basically that more providers using a standard lowers the consumer switching cost as well as ensuring that they will not be technologically stranded if their provider shuts down.

[14] Most broadband Internet customers prefer their current supplier's service because they are used to it, and have learned to like the benefits it provides (purchasing goods through Internet, chatting, and so on).

[15] We do not weight prices when calculating the annual fee, which implicitly assumes that consumers are distributed uniformly across the different speeds offered by each firm.

[16] We thank one anonymous referee for pointing out that limit. The reader is referred e.g. to Farrell and Shapiro (1988) that makes the distinction between old and new users.

[17] This price excludes the cost of the modem.